TAKE-AWAYS

KEY SCIENTIFIC FINDINGS

Spruce-Fire and Aspen Science Symposium
Montrose, CO
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CLIMATE

- Umbrella variable – past and future
- Past 100 years: Southwest CO increased by 2 degrees F
- Projections, irrespective of emissions scenario, indicate more warming
  - Warmer and longer frost-free summer
  - Heavier precip events
  - Earlier snowmelt
  - *Flooding events lower; moderated by storage systems?*
- Effects on forest?
  - More beetle and drought mortality
  - Greater extent of fires
  - Greater severity of fires

ASPEN DECLINE

- Key factors:
  - Drought stress → insects/disease → adult mortality
  - Lack of fire
    - Aspen is a primary successional state; fire-adapted
    - Fire resets successional state
      - Conifers competing/encroaching at present
  - Multiple stressors inhibiting regeneration (SAD)
    - Excessive browsing:
      - 2-3 consecutive years of excessive browsing, and the root system is depleted (clone regeneration)
    - Ideal conditions required for seedling germination
      - bare mineral soil; constant water source; sunlight

SPRUCE-FIR ECOLOGY

- FIRE
  - Fire regime is on return interval of 350+ years
  - Based on climate (not amount of fuel)

- BEETLE
  - Over 200 years' data, similar **extent** of beetle kill today as in past
  - **Climate** is driver (not fire suppression)
  - **Mortality** is 4-5x greater (80-95% mortality today)

FIRE POST-BEETLE

- Across the Rockies and forest types: results indicate fire incidence is NOT higher in beetle-affected forests (22 years' data)
  - *Continuing to study factors that led to regional differences in incidence of fire (species composition, timing, extent)*
- Rate of fire spread much faster in beetle-affected stands
  - Multiple stages of beetle kill with differing effects on wildfire
  - Dry needles/Lichens/Limbs → Aerial spotting → Crown spread
  - Behavior less predictable
- Homogeneous stands/blowdowns compound fire intensity
- Feedback mechanism: beetle kill effects on the microclimate
  - Reduced canopy→ higher winds, snowmelt more rapid, fuels hotter and drier → more intense fire

WATER

- Beetle-affected trees affect hydrologic regime
  - Trees effective at holding and sublimating snow
  - Reduced canopy cover → greater snow depth
- Roughness on the surface affects the hydrologic regime
  - Depth of residual fuels = snow depth
  - Roughness is dependent on type/extent of treatment
    - (lop and scatter, scarified, whole tree harvest)
- Hands-off approach would result in higher water yield but not necessarily anomalous flooding
  - Yet management redistributes water
- BUT fire is a monkeywrench!

CARBON STORAGE

- Spatial scale required for carbon offsets in forests, on global scale or national scale, is immense
  - Prius, agricultural land conversion examples
- Carbon balance in beetle-affected forest:
  - Decomposition of dead trees vs regeneration of new seedlings is key
  - Rate of carbon loss in burned forest vs dead forest: roughly similar rates
    - 10% lost in fire in initial pulse (crown fire example)
- Management generally lowers carbon storage of forest, but can be enhanced via:
  - Harvest for long-lived forest products
  - Techniques to foster increased regeneration

REGENERATION

- Spruce Fir:
  - Maximum 4-5x tree height-size canopy gap for regeneration
    - Proximal seed source and sufficient light
    - Lack of understory veg competition
- Regeneration rates post-fire in beetle-affected areas 5x higher
  - Yet regeneration in beetle-affected area where salvage logging was conducted, followed by fire, was inhibited
    - *Unclear mechanism*
    - *Type of salvage and methods used may play role in regeneration rates*
- Woody debris/residuals retain soil moisture
  - Increased shading; increased snowpack due to terrain roughness
  - Ecological threshold for regeneration is below the fuel hazard threshold